

Mucool Shielding Requirements

Emission Mode

Beam to Emission Absorber in MTA Stub

Date: 7/13/2010

Base Primary Beam Energy (GeV): 1000.00
Base Primary Beam Intensity (protons/pulse): 2.00E+13

Primary Beam Energy (GeV):	0.4
Primary Beam Intensity (protons/pulse):	1.60E+13
Accelerator Cycle Time (sec):	6
Number of Trips per Hour:	15
Number of Protons per Hour:	9.60E+15

Standard Cossairt category table, assuming 2E13 protons/pulse at E=1000 GeV, 57-sec cycle time

Accident dose limits from Fermilab Radiological Control Manual, January 1997 revision, tables 2-7A and 2-7B

Note: For categories 6 through 10, standard assumes one trip allowed per hour will give dose limit

Dose D, per hour	A. Beam on Magnet in Enclosure		B. Beam on Pipe in Enclosure		C. Beam on Buried Pipe	
	Category	Standard (e.f.d.)	Category	Standard (e.f.d.)	Category	Standard (e.f.d.)
D < 1mrem	1A	22.0	1B	20.0	1C	24.0
1 ≤ D ≤ 5 mrem	2A	19.8	2B	17.8	2C	21.8
1 ≤ D ≤ 10 mrem	2SE-A	19.3	2SE-B	18.3	2SE-C	20.8
10 ≤ D ≤ 100 mrem	3A	16.5	3B	15.5	3C	18.0
100 ≤ D ≤ 500 mrem	4A	15.0	4B	13.0	4C	16.5
500 ≤ D ≤ 1000 mrem	5A	14.0	5B	12.0	5C	15.5
D < 1mrem	6A	17.3	6B	15.3	6C	18.3
1 ≤ D ≤ 5 mrem	7A	15.2	7B	13.2	7C	16.2
5 ≤ D ≤ 100 mrem	8A	11.7	8B	9.7	8C	12.7
100 ≤ D ≤ 500 mrem	9A	10.2	9B	8.2	9C	11.2
500 ≤ D ≤ 1000 mrem	10A	9.2	10B	7.2	10C	10.2
D ≤ 250 mrem/trip	11A	--	11B	--	11C	--

Scaled Thickness Requirements for this intensity, energy, and cycle time:

Dose D, per hour	A. Beam on Magnet in Enclosure			B. Beam on Pipe in Enclosure			C. Beam on Buried Pipe		
	Cossairt Category	Standard (e.f.d.)	Scaled Thickness	Category	Standard (e.f.d.)	Scaled Thickness	Category	Standard (e.f.d.)	Scaled Thickness
D < 1mrem	1A	22.0	16.9	1B	20.0	14.9	1C	24.0	18.9
1 ≤ D ≤ 5 mrem	2A	19.8	14.7	2B	17.8	12.7	2C	21.8	16.7
1 ≤ D ≤ 10 mrem	2SE-A	19.3	14.2	2SE-B	18.3	13.2	2SE-C	20.8	15.7
10 ≤ D ≤ 100 mrem	3A	16.5	11.4	3B	15.5	10.4	3C	18.0	12.9
100 ≤ D ≤ 500 mrem	4A	15.0	9.9	4B	13.0	7.9	4C	16.5	11.4
500 ≤ D ≤ 1000 mrem	5A	14.0	8.9	5B	12.0	6.9	5C	15.5	10.4
D < 1mrem	6A	17.3	12.7	6B	15.3	10.7	6C	18.3	13.7
1 ≤ D ≤ 5 mrem	7A	15.2	10.6	7B	13.2	8.6	7C	16.2	11.6
5 ≤ D ≤ 100 mrem	8A	11.7	7.1	8B	9.7	5.1	8C	12.7	8.1
100 ≤ D ≤ 500 mrem	9A	10.2	5.6	9B	8.2	3.6	9C	11.2	6.6
500 ≤ D ≤ 1000 mrem	10A	9.2	4.6	10B	7.2	2.6	10C	10.2	5.6

Note:
Categories 6 through 10 assume hourly trip rate is limited to value in "Number of Trips per Hour" cell above, and requirement is **independent** of cycle time.

Notes:

1. A new invented category, designated "2SE," is assigned for the dose interval less than 10 millirem per hour. Values defined are "2SE-A," "2SE-B," and "2SE-C."
2. 1000 GeV shielding requirements are scaled downward from those for 100 mrem/hour (category 4) in the Cossairt table.
3. Apparatus has been added to handle Category values with either (a) a number followed by one character or (b) a number followed by four characters.

Name/Date	
Originated	W. Higgins 14-Apr-10
Checked	